Thoroughfares and Apartment Values

*Paul K. Asabere**
*Forrest E. Huffman**

***Abstract*. While the monocentric urban models were once adequate for predicting the declining rent gradients for North American cities, the advent of a transportation system with major arteries such as turnpikes, thoroughfares and commuter rails has distorted the rent gradient for many cities. In this study we examine the rent (or value) gradient for the City of Philadelphia with special reference to the impact of two major urban thoroughfares on apartment values. We find that apartment values decline by approximately 2.2% and 3.8% per block from the major thoroughfares, while holding distance to the CBD and standard variables constant. As to be expected, distance to the CBD still continues to exert a dominant influence on apartment values in spite of the impacts of the thoroughfares. The findings are consistent with 'axial growth theory'.**

Introduction

The role of location as a major determinant of property values is the cornerstone in the literature of urban economics. Monocentric urban models pioneered by Muth (1969) and Mills (1967) simplified the notion of location (accessibility) by assuming that the destination point for suburban residents is the central business district (CBD) and that transportation costs to the CBD are the same from all suburban locations. These assumptions led to the well-known predictions that rents and density should decline with distance (transportation costs) from the CBD. This monocentric model was adequate for describing many North American cities until the advent of the 'freeway' system with turnpikes and thoroughfares (or radial freeways).

With the advent of the freeway system, the rent structure started to change. Rents along thoroughfares that ran into the city began to rise, forming a rent (or value) gradient outside of the CBD. These trends appear to be consistent with the "direction-of-least-resistance theory" or axial growth theory by Hurd (1903). Most recently, it has been noted that proximity to a freeway or commuter train should produce higher rents than locations of similar distances (Voith, 1991).

In recent years a handful of empirical studies have been published on accessibility-related declining rent gradients with expected results. These include: Voith (1991); Quigley (1985); Anas (1981); Lerman (1977); Gin and Sonstelie (1992); and Boyce, Allen and Tang (1976). Other studies on declining rent gradients, however, have yielded contradictory findings. Examples of studies finding either positive or insignificant rent gradients include: Cropper and Gordon (1991); Blackley and Follain (1987); and Heikkila, Gordon, Kim, Peiser, Richardson, and Dale-Johnson (1989).[1]

*School of Business and Management, Temple University, Philadelphia, Pennsylvania 19122.
Date Revised—May 1994; Accepted—July 1995.

This study examines the potential impacts of proximity to major urban thoroughfares (or radial freeways) on apartment values. A few studies have analyzed apartment rents including: Frew, Jud and Winkler (1990); Guntermann and Norrbin (1987); and Sirmans, Sirmans and Benjamin (1994). What sets this study apart from earlier research on apartments is our use of apartment values instead of rents and our special reference to the significance of thoroughfares. The central premise of this study is that apartment buildings located close to thoroughfares will attract premium values. The balance of the paper is organized in the following manner: Section two presents the empirical framework; section three describes the data and the empirical findings; and the fourth section presents the summary and conclusions of our study.

The Empirical Framework

The principal hypothesis of our study is that urban apartment buildings at major thoroughfare locations will attract premium values. This will be consistent with the "direction-of-least-resistance theory" or the "axial growth theory" which was developed by Richard M. Hurd in 1903. According to Hurd, residential areas tend to develop along the fastest transportation routes. He spoke of axial growth as characterizing city growth, based on quick access to and from the business center by way of turnpikes and street railways.

The primary objective of this study is simply to detect the potential impacts of major thoroughfares on apartment values, other influential variables held constant. Specifically, we are attempting to measure the impact of two thoroughfares (Broad Street and Market Street) in the City of Philadelphia. To measure the impacts of the two major thoroughfares on apartment prices, a standard hedonic model represented by equation 1 is employed such that:

$$\begin{aligned} \text{Log}SPi = {} & \text{Log}\beta_0+\beta_1 BROAD+\beta_2 MARKET+\beta_3 1/CBD+\beta_4 FLOORS \\ & +\beta_5 \text{Log}BLR+\beta_6 \text{Log}AREA+\beta_7 TINY+\beta_8 MASONRY \\ & +\beta_9 OWNER+\beta_{10} VACANT+\beta_{11} RENT+\beta_{12} HHINC \\ & +\beta_{13} YR81+\beta_{14} YR82+\beta_{15} YR83+\beta_{16} YR84 \\ & +\beta_{17} YR85+\beta_{18} \text{YR}86+\beta_{19} \text{YR}87+\beta_{20} YR88 \\ & +\beta_{21} YR89+\beta_{22} YR90+\beta_{23} YR91+\text{Error}\,, \end{aligned} \tag{1}$$

where:

$\text{Log}SP_i$ = the sales price of the ith apartment in logs;
$BROAD$ = distance in blocks from the *Broad* Street thoroughfare;
$MARKET$ = distance in blocks from the *Market* Street thoroughfare;
$1/CBD$ = inverse of distance in blocks from the midpoint of the *CBD*;
$FLOORS$ = number of *floors* or stories;
$\text{Log}BLR$ = the ratio of *building-to-land* property assessment in logs (this variable is intended to control for intensity of development, since we do not have a floor space variable);[2]
$\text{Log}AREA$ = the *area* of the lot in square feet (in logs);
$TINY$ = a dummy variable assigning 1 to the smaller one-to-four-unit apartments and 0 to apartments over-four units;
$MASONRY$ = (1,0) dummy variable *for masonry* construction vs. all other;
$OWNER$ = (1,0) dummy variable for individual *ownership* (sole-proprietor);

VACANT = percent *vacancy* in the census tract (1990);
RENT = median *rent* in the census tract (1990);
HHINC = median *household income* of the census tract (1990);
*YR*81 to *YR*91 = *year* of sale dummy variables;
Error = an error term.

Description of Broad and Market Streets, the Data and the Estimation Results

The City of Philadelphia is a planned city with a streetscape primarily of straight streets at right angles. Bisecting the City on its north-south axis is Broad Street. Market Street serves as the major east-west artery. City Hall is located at their intersection within the CBD. Broadly speaking, the CBD is a three-square-mile area containing over 50,000 residents, nearly 300,000 jobs and 40 million square feet of office space. City planners estimate that by the year 2000, the area will contain over 80,000 jobs and generate over $150 million annually in tax revenues (Philadelphia City Planning Commission, 1986).

Both Broad Street and Market Street serve as primary access and transportation routes for CBD residents and visitors in the CBD. In addition to serving as highways for destination points in and outside the CBD, the streets are also important public transit routes. In addition to city bus routes, the Broad Street Subway runs the length of the City under Broad Street. The Frankfort-Market Elevated Rail line (the "El") runs under Market for its entire length. The Subway carries about 116,000 passengers daily while the El carries about 152,000 riders daily.[3] No other street in the City approaches the importance of these two main traffic arteries.

Our data consist of 408 sales (all recorded market transactions as derived from the local MLS) of apartment buildings in the City records from April 1980 to July 1991. In addition to sales price and date of sale, the records also contain the variables for number of floors; lot size; type of construction; and the tax assessments for land and building. We include from the 1990 census reports for the tract in which each building is located the neighborhood quality variables: median household income; percentage of houses vacant in the tract; and median rental levels.[4] We account for market conditions over time by including a series of dummy variables for each year from 1981 to 1991 (*YR*81 to *YR*91 relative to *YR*92).

Finally, we use three location variables: distance to the center of the CBD (the intersection of Broad and Market, and the location of City Hall) and distance to our two variables of interest: Broad Street and Market Street, all in city blocks. Descriptive statistics for relevant variables and acronyms are in Exhibit 1.

Of our hypotheses, we expect our building size variable (*FLOORS*), the building intensity variable (Log*BLR*) and lot size (Log*AREA*) to have positive effects on apartment building values. Variables for smaller sized buildings (*TINY*) and the less preferred masonry construction (*MASONRY*) would have negative impacts. As for our neighborhood variables, we expect higher vacancy rates (*VACANT*) to have a negative impact and higher rental levels (*RENT*) and household incomes (*HHINC*) to have positive impacts on value. We form no *a priori* opinion on our year-of-sale variables *YR*81 to *YR*91, since the period saw both increases and decreases in real estate markets in Philadelphia, or on the ownership variable (*OWNER*).

Exhibit 1
Summary Statistics on Relevant Variables

Variable	Mean	Std Dev.
LogSP_i	12.134	1.289
CBD	13.221	9.817
1/*CBD*	.123	.087
BROAD	12.096	10.064
MARKET	4.096	2.936
FLOORS	3.267	.358
Log*BLR*	1.309	.643
Log*AREA*	7.928	.774
TINY	.422	.494
MASONRY	.908	.150
OWNER	.502	.867
VACANT	.114	.060
RENT	245.912	63.764
HHNC	13093.005	4504.444

Finally, of our three accessibility variables, we expect our inverse distance to the CBD (1/*CBD*) variable to have a significantly positive impact on value while major measures to our major thoroughfares (*BROAD* and *MARKET*) should yield significantly negative impacts on values (as distance increases).

Using our apartment data described, equation (1) estimated using OLS. The multiplicative functional form for which a transformed version is represented by equation (1) is adopted since several studies have found that the relationships between house prices and distance from CBD, lot size, building size and so forth are generally nonlinear (see for example, Kowalski and Colwell, 1986; Colwell and Sirmans, 1978).

The results are reported in Exhibit 2. The adjusted coefficient of determination relatively high for the model and variance inflation factors (VIF's) are all less than 10.0, an indication of the absence of serious multicollinearity among variables. The impacts of various building, neighborhood and time-of-sale variables are generally as expected. Covering the control variables first, building size and condition variables (*FLOOR*) and (Log*BLR*), and lot size (Log*AREA*) are significantly positive at the 95% level of confidence. The dummy variable for small apartment buildings (*TINY*) is significantly negative at the 95% level of confidence as expected. The dummy variable for individual ownership is also significantly positive, suggesting that individuals pay relatively higher prices versus corporations. Neighborhood quality variables; proportion of houses vacant in the census tract (*VACANT*), and median rental levels (*RENT*) are significantly negative and significantly positively, respectively, at the 95% level of confidence as expected. Our dummy variables for time of sale are generally significant and positive suggesting a period of higher prices relative to sales recently occurring in 1992. Remaining explanatory variables (*MASONRY, HHINC, YR*81, and *YR*82) are statistically insignificant.

Our accessibility variables produced very interesting results. The magnitude of the

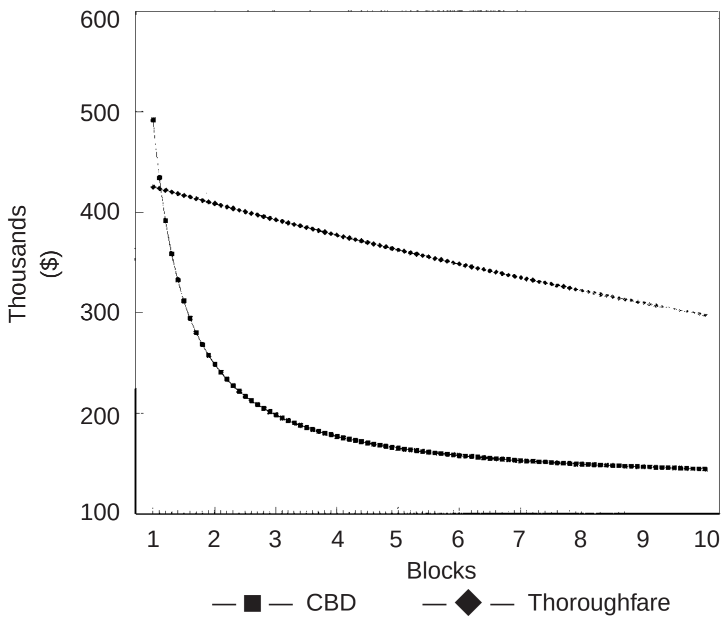
Exhibit 2
The Regression Results
Dependent Variable is Log*SPrice*

Variable	Coeff.	*T*-Ratio	VIF
1/*CBD*	1.3666*	2.146	2.80
BROAD	−.0384*	−5.375	4.69
MARKET	−.0221*	−1.732	1.27
FLOORS	.2693*	2.542	1.30
LOG*BLR*	.3346*	6.074	1.14
LOG*AREA*	.8284*	15.600	1.53
TINY	−.4138*	−3.991	2.38
MASONRY	−.2961	−.434	1.04
OWNER	.1079*	1.926	2.14
VACANT	−4.0400*	−5.748	1.62
RENT	.0034*	2.628	6.21
HHINC	2.3E-06	.124	6.69
*YR*81	−.0800	.415	2.51
*YR*82	.0090	.47	2.84
*YR*83	.4275*	2.268	2.86
*YR*84	.4533*	2.545	3.31
*YR*85	.6460*	3.503	3.15
*YR*86	.9172*	5.105	3.47
*YR*87	.8825*	4.715	2.88
*YR*88	1.1154*	5.986	2.79
*YR*89	1.3090*	6.294	2.18
*YR*90	.9178*	3.041	1.40
*YR*91	1.1687*	3.876	1.39
Constant	4.0336*	4.34	—
Adj R^2	.72		
DF	407		
F	48.79		

*significant at the 90% level or higher

coefficient of 1/*CBD* is 1.3666 and significant at the 95% level of confidence. Our two variables of interest, *BROAD* and *MARKET,* are both significantly negative at the 95% and 90% level of confidence, respectively. The magnitude of the estimated coefficient on *BROAD* is −.038 meaning that, on average, apartment building prices drop by approximately 3.8% per building for each block away from Broad Street. The corresponding figure for *MARKET* is −.022 meaning that, on average, apartment building prices drop by roughly 2.2% per block away from Market Street. Exhibit 3 represents value gradients with respect to distance from the CBD and Broad Street (one of the thoroughfares). The graph shows that apartment values decline significantly away from Broad Street as well as from the CBD.

Exhibit 3
Value by City Block from Thoroughfare and CBD



Summary and Conclusions

This paper is further empirical evidence of the importance of major transportation systems to property values. The findings are consistent with our hypothesis that apartments situated along major thoroughfares sell at premium prices relative to apartments that are located on non-major streets. The value gradients based upon Exhibit 2 are $-.038$ and -0.22 for Broad and Market Streets, respectively. These imply that apartment values decline away from Broad Street by approximately 3.8% per block. The corresponding figure for Market Street is roughly 2.2% per block. Our proximity variable for distance to central business district ($1/CBD$) is also significant with an estimated coefficient of 1.3666. This implies that the CBD continues to exert a dominant influence on apartment values in spite of emergent impacts of transportation systems. While this study is based upon just two thoroughfares within the City the findings may be applicable to other major highways in or around cities.

Notes

[1]It may be, as suggested by White (1988), that although the underlying model of location based upon accessibility is reasonable, assumptions of monocentric cities and ubiquitous transportation systems are not. Steen (1986), in a model of bid-rents with non-ubiquitous transportation, suggests that rent differences should only arise if a locale has accessibility advantages where individuals can choose among both residential and employment locations.

[2]Prior research has led us to conclude that building age for properties in Philadelphia, especially for property in the CBD, is a poor indicator of building condition. The average age of buildings in the City has been estimated elsewhere to be well over 50 years old with many buildings in the area well over 100 years old. Many have undergone numerous renovations and changes. Many of the oldest buildings, because of their historic significance, are the most valuable. Anecdotal evidence suggests that the older and less maintained buildings usually carry lower building-to-land assessment ratios and vice versa. We therefore assume that our building intensity variable captures the "significant condition" of the building as well as, and perhaps better than, a standard age variable (which is generally unavailable).
[3]Data obtained from the Southeastern Pennsylvania Transportation Authority (SEPTA) for 1992 weekday travel.
[4]As mentioned by an anonymous reviewer, the use of 1990 vacancy rates, median rents and median incomes to represent a neighborhood create problems since neighborhoods change over time. We recognize this potential problem, however, anecdotal evidence seems to suggest that these city neighborhoods have remained relatively static for several years.

References

Anas, A., The Estimation of Multinomial Logit Models of Joint Location and Travel Model Choice from Aggregated Data, *Journal of Regional Science,* 1981, 21:2, 223–42.

Blackley, D. M. and J. M. Follain, Tests of Locational Equilibrium in the Standard Urban Model, *Land Economics,* 1987, 63:1 46–61.

Boyce, D. E., W. E. Allen and F. Tang, Impact of Rapid Transit on Residential Property Sales Prices, in M. Chatterji, editor, *Location and Regional Space Development,* London, U.K.: Pion Limited, 1976.

Colwell, P. F. and C. F. Sirmans, Area, Time, Centrality and the Value of Urban Land, *Land Economics,* 1978, 54, 514–19.

Cropper, M. L. and P. L. Gordon, Wasteful Commuting: A Re-examination, *Journal of Urban Economics,* 1991, 29:1, 2–13.

Frew, R. J., G. D. Jud and D. T. Winkler, Atypicalities and Apartment Rent Concessions, *Journal of Real Estate Research,* 1990, 5:2, 195–201.

Gin, A. and J. Sonstelie, The Streetcar and Residential Location in Nineteenth Century Philadelphia, *Journal of Urban Economics,* 1992, 32, 92–107.

Guntermann, K. L. and S. Norrbin, Explaining the Variability in Apartment Rents, *AREUEA Journal*, 1987, 15:4, 321–40.

Heikkila, E. J., P. Gordon, J. I. Kim, R. B. Peiser, H. W. Richardson, and D. Dale-Johnson, What Happened to the CBD-Distance Gradient?: Values in a Polycentric City, *Environment and Planning A,* 1989, 21:2, 221–32.

Hurd, R. M., *Principles of City Land Values,* New York: Record and the Guide, 1903 (1924), 13–15.

Kowalski, J. G. and P. F. Colwell, Market Versus Assessed Values of Industrial Land, *AREUEA Journal,* 1986, 14:2, 361–73.

Lerman, S. R., Location, Housing, Automobile Ownership and Mode to Work: A Joint Choice Model, *Transportation Research Record,* 1977, 610, 6–11.

Mills, E. S., Transportation and Patterns of Urban Development, *American Economic Review,* May 1967, 197–210.

Muth, R. F., *Cities and Housing: The Spatial Pattern of Urban Residential Land Use,* Chicago: University of Chicago Press, 1969.

Philadelphia City Planning Commission, *Plan for Center City,* Philadelphia: PCPC, 1986.

Quigley, J. M., Consumer Choice of Dwelling, Neighborhood and Public Housing, *Regional Science and Urban Economics,* 1985, 15:1, 41–63.

Sirmans, G. S., C. F. Sirmans and J. D. Benjamin, Apartment Rent Concessions and Occupancy Rates, *Journal of Real Estate Research,* 1994, 9:3, 299–312.

Steen, R. C., Nonubiquitous Transportation and Urban Population Density Gradients, *Journal of Urban Economics,* 1986, 20:1, 97–106.

Voith, R., Transportation, Sorting and House Values, *AREUEA Journal,* 1991, 19:2, 117–37.

White, M. J., Urban Commuting Journeys Are Not "Wasteful," *Journal of Political Economy,* 1988, 96:5, 1097–1110.